

29.11.2004

REC'D 23 DEC 2004

WIPO

PCT

PA 1247450

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

November 10, 2004

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 10/683,269

FILING DATE: October 14, 2003

**PRIORITY
DOCUMENT**

SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR (b)

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS



M. LEE
Certifying Officer



BEST AVAILABLE COPY

COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.: VX032564
Date: 10/14/03

Dear Sir: Transmitted herewith for filing is the **UTILITY** patent application of:

Inventor(s): Shota MURAKAMI & Tsuyoshi YOSHIDA

22386 U.S. PTO
10/683269
10/14/03

Title: PIN ASSEMBLY FOR TRACK ROLLER BOGEY OF TRACK-TYPE DRIVE SYSTEM

18 pages of written description, claims and abstract.
 FIVE sheet(s) of formal drawings.
 Executed Declaration and Power of Attorney
 Assignment Papers (cover sheet and documents)
 Certified Copy of Priority Documents
 Information Disclosure Statement
 Return Postcard Receipt
 Preliminary Amendment

Nucleotide and/or Amino Acid Sequence Submission including:
 Computer Readable Form (CRF)
 Specification Sequence Listing on:
 CD-ROM or CD-R (2) copies); or
 paper
 Statements verifying identity of above copies.

Other: _____

Filing Fee, calculated as shown below:

(Col. 1)	(Col. 2)
FOR:	NO. FILED
BASIC FEE	
TOTAL CLAIMS	6 - 20 = 0
INDEP. CLAIMS	2 - 3 = 0
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIMS PRESENTED	

* If the difference in Col. 1 is less than zero, enter "0" in Col. 2

SMALL ENTITY		OTHER THAN A SMALL ENTITY	
RATE	FEE	RATE	FEE
	\$ 385.00		\$ 770.00
x 9	\$	x 18	\$
x 43	\$	x 86	\$
+ 145	\$	+ 290	\$
TOTAL	\$	TOTAL	\$ 770.00

Applicant claims small entity status. See 37 CFR 1.27.
 One check two checks in the amount of \$ 770.00 & 40.00 to cover the filing fee and assignment recordation is (are) enclosed.
 The Commissioner is hereby authorized to charge and credit our Deposit Account No. 22-0256 as described below. A duplicate of this sheet is attached.

Charge the amount of \$ _____ to cover the filing fee and assignment recordation.
 Charge deficiencies in the enclosed fees or any additional filing fees required under 37 CFR 1.16.
 Charge any patent application processing fees under 37 CFR 1.17.
 Charge the issue fee set in 37 CFR 1.18 at the mailing to the Notice of Allowance pursuant to 37 CFR 1.311(b).
 Credit any overpayment.

DIRECT ALL CORRESPONDENCE TO:

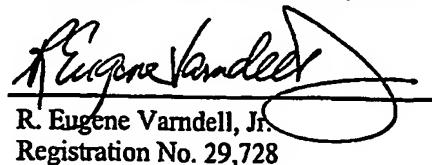
VARNDELL & VARNDELL, PLLC
106-A South Columbus Street
Alexandria, VA 22314
(703) 683-9730

Customer Number
021369 →



021369
PATENT TRADEMARK OFFICE

Respectfully submitted,
VARNDELL & VARNDELL, PLLC


R. Eugene Varndell, Jr.
Registration No. 29,728

TITLE OF THE INVENTION

PIN ASSEMBLY FOR TRACK ROLLER BOGIE OF TRACK-TYPE DRIVE SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a pin assembly, and more particularly to a pin assembly for pivoting a track roller bogie (hereinafter, refer simply to a bogie) of a track-type drive system.

2. Description of the Prior Art

The track-type drive system corresponds to a system driving a vehicle by driving a track connecting links having track shoes in an annular shape by pins by means of a sprocket. The drive system mentioned above has a larger ground contact area in comparison with a drive system employing wheels, and is mainly used in a vehicle driving on a rough ground, a snow ground, a weak ground, a battlefield, a civil work field and the like.

A typical track-type drive system is shown in Fig. 1. An idler 2 is pivoted to one end of a track frame 1 swingably attached to a vehicle body, and a sprocket 3 is pivoted to the vehicle body in a direction of another end. A bogie 4 provided with a track roller 5 is mounted to a lower side of the track frame 1. In general, the track

roller or the bogie provided with the track roller is mounted to the track frame in accordance with one type that a position of the track roller is fixed, or another type that the track roller is mounted so as to vertically swing. Fig. 1 shows a bogie of the latter type that the track roller is mounted so as to freely swing. A crawler belt 6 is wound around a periphery of the idler 2, the track roller 5 and the sprocket 3. In accordance with this type, since the track roller 5 can follow to a vertical motion of the crawler belt 6, it is possible to more stably ground the vehicle.

Fig. 4 shows a structure cited from U.S.Pat.No. 6,607,256, and shows details in the periphery of the pivotally supported portion of the bogie 4 to the track frame 1 in the swing-type bogie as shown in Fig. 1. The bogie 4 in these drawings is constituted by a first bogie link 8 and a second bogie link 23. First, another end of the first bogie link 8 is bifurcated, and the bifurcated portions are respectively pivoted to the track frame 1 by pins 14. A second bogie link 23 is rotatably mounted to one end of the first bogie link 8, and the track roller 5 is mounted to an end portion of the second bogie link so as to freely roll.

Viewing the pivotally supported portion of the first bogie link 8 to the track frame 1 in detail, a pair of

left and right brackets 7 and 7 are arranged on an underside of the track frame 1, and an opening portion is provided in each of the brackets. A first ring 9 and a third ring 11 are fixed respectively to inner peripheries of the opening portions in a pair of left and right brackets. The pins 14 are fixed to inner peripheral portions of the first ring 9 and the third ring 11. A second ring 10 is annularly provided between the first ring 9 and the third ring 11 in such a manner as to freely rotate with respect to the pin 14. Another end of the first bogie link is bifurcated in correspondence to a pair of left and right brackets 7 and 7, and an outer periphery of the second ring 10 is fixed to an opening portion existing in the branch portion.

In this case, it is necessary to lubricate a rotating portion between the second ring 10 and the pin 14, and a slide contact portion among the first, second and third rings by using a lubricant, however, is sealed from an outer portion for the purpose of preventing the lubricant from leaking to the external portion and the purpose of insuring the rotating portion and the slide contact portion against soil grains such as sands, silts and the like. Fig. 5 is an enlarged view around the rotating portion and the slide surface between the second ring 10 and the third ring 11. For the purpose of the sealing mentioned

above, annular recess portions are provided in positions opposing to contact surfaces of the respective rings, and a pair of left and right face seals 15 and 15 are inserted thereto. The face seals 15 and 15 are pressure contacted by O-rings 16 and 16 so as to prevent a lubricating oil supplied via a lubricant passage 17 from flowing out to an outer portion of the pivotally supported portion together with the O-rings 16 and 16, and prevent the soil grains from making an intrusion into the rotating portion and the sliding surface from the outer portion.

Further, spacers 13 formed as a ring having a rectangular cross sectional shape are slidably arranged in inner sides of the face seals 15 and 15 in a radial direction so as to be slidable with respect to each of the second ring 10, the third ring 11 and the pin 14 in a contact state therewith. The spacer 13 is provided for the purpose of transmitting a load in a thrust direction generated in the case that a drive surface is unevenly brought into contact with the track shoe with keeping a level difference in a lateral direction (a lateral direction in Fig. 4) of the track shoe, between the first ring 9 and the second ring 10.

The sealing and lubricating functions required in the contact portion among the first, second and third rings are achieved by the structure of the pivotally supported

portion mentioned above, however, since the contact portion requires totally ten parts comprising a pair of face seals, a pair of O-rings and the spacers, it is troublesome to assemble them. Further, in the spacer, it is necessary to lubricate all the outer peripheral surface thereof, however, since the cross sectional shape is rectangular, the lubricating oil is hard to smoothly circulate around the outer surface, so that there is a problem that a service life of the parts is shortened due to seizure or the like. In other words, since a labyrinth is formed in the portion to be lubricated, there is a problem that a lack of lubrication may be generated. Further, in order to solve the problem, there can be considered a method of improving a lubricating property by making the spacer by a porous material such as a porous cast iron or the like, however, in this case, there is a problem that a manufacturing cost is increased.

SUMMARY OF THE INVENTION

The present invention is made by taking the circumstances mentioned above into consideration, and an object of the present invention is to provide a pin assembly which can more easily assemble a pivotally supported portion and solves the problem of the lack of lubrication caused by the rectangular spacer, and a track-type drive

system which employs the pin assembly.

In order to achieve the object mentioned above, in accordance with the present invention, there is provided a pin assembly for a bogie of a track-type drive system, comprising:

a pin having a lubricant charging hole and a lubricant delivering hole delivering the lubricant from the lubricant charging hole to an outer peripheral portion in an inner portion thereof;

a first ring having a contact surface with the pin in one end so as to be firmly attached to the pin and having an outer diameter D_1 ;

a second ring brought into contact with another end side of the first ring in an axial direction of the pin so as to be rotatably pivoted to the pin and having an outer diameter D_2 ; and

a third ring brought into contact with another end side of the second ring in an axial direction of the pin so as to be firmly attached to the pin and having an outer diameter D_3 ,

wherein a part of a ring end surface contacted among the first, second and third rings has an annular recess portion, and the annular recess portion consists of a sealing means between rings for sealing therebetween, and the outer diameters D_1 , D_2 and D_3 have a relation $D_1 < D_2$

< D₃ .

Further, in accordance with the present invention, there is provided a pin assembly, wherein the slide portion among the first ring, the second ring and the third ring is constituted by a slide contact surface with which each of the rings is directly contacted, and a seal surface of the sealing means in correspondence to each of the slide contact surfaces, and the slide contact surface and the seal surface form a substantially one flat plane in a radial direction.

In accordance with another invention, there is provided a track-type drive system comprising:

a bogie having a track frame, an idler, a sprocket, a carrier roller and a track roller and pivoted to the track frame; and

a crawler belt wound around them,

wherein the bogie is pivoted to the track frame by the above pin assembly.

In accordance with the other invention, there is provided a track-type drive system comprising:

a bogie having a track frame, an idler, a sprocket, a carrier roller and a track roller and pivoted to the track frame; and

a crawler belt wound around them,

wherein the bogie is constituted by a first bogie

link pivoted to the track frame, and a second bogie link pivoted to the first bogie link and to which the track roller is mounted, and

wherein the second bogie link is pivoted to the first bogie link by the above pin assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view showing a general track-type drive system;

Fig. 2 is a cross sectional view of a pin assembly in accordance with the present invention;

Fig. 3 is a schematic view of an assembly of a pivotally supported portion of the bogie in accordance with the present invention;

Fig. 4 is a cross sectional view of a conventional bogie; and

Fig. 5 is an enlarged view of a part of a conventional pivotally supported portion of the bogie.

DETAILED DESCRIPTION OF THE INVENTION

A description will be given of a particular embodiment of a pin assembly in accordance with the present invention, and a pivoting structure using the same.

Fig. 2 shows a cross sectional view of a pin assembly in accordance with the present invention, and Fig. 3 shows

a schematic view of an assembly of a pivotally supported portion of the bogie of a track-type drive system achieved by the pin assembly.

A pin 14 is made of a carbon steel, and has a concentric cylindrical hole open in a left side of the pin 14 in Fig. 2. A right side of the hole is formed as an opening having a small diameter, and is closed by a detachable lid. A left side of the pin 14 is pressure inserted to a first ring 9 closing one end (a left side) of the opening so as to form a contact surface 24 with the pin 14, and strikes a right side of the contact surface 24. The cylindrical hole within the pin 14 strikes the contact surface 24, thereby forming the lubricant charging portion 19, and a lubricant such as a lubricating oil, a grease or the like is charged from a small-diameter opening arranged in a right side of the pin 14.

A second ring 10 is rotatably pivoted to the pin 14 in adjacent to a right side of the first ring 9. Since the first ring 9 is fixed to the pin 14, a slide portion 21 is formed between both the elements in accordance with a rotation of the second ring 10. The slide portion 21 is constituted by three parts. First, a slide contact portion 26 in which the first ring 9 is directly brought into contact with the second ring 10 is provided in a portion closest to an inner diameter side of the slide portion 21

in a radial direction. The slide contact portion 26 forms one flat surface in a radial direction. Since the first ring 9 and the second ring 10 are manufactured by the same material (for example, a chrome molybdenum steel), a surface hardening treatment such as a carburizing and quenching or the like is applied to a portion forming the slide contact surface 26 for the purpose of preventing a seizure. Further, the lubricant is supplied from the lubricant charging portion 19 mentioned above via the lubricant delivering hole 18 and the lubricant passage 17.

A sealing means having a sealing surface 28 for sealing the lubricant is provided in an outer diameter side of the slide contact surface 26. The sealing means is constituted by a pair of right and left face seals 15 and 15 and O-rings 16 and 16. These are clamped by annular recess portions provided in portions corresponding to the first ring and the second ring, and the face seals 15 and 15 are opposed to each other so as to form a contact surface corresponding to the sealing surface 28. The sealing surface 28 is placed on substantially the same plane as the slide contact surface 26.

An outer peripheral surface in which the first ring 9 and the second ring 10 are opposed to each other by an interval about 1 mm is formed in an outermost side of the

slide portion 21. A pressing force of the O-ring is set small such that a force is transmitted mainly by the slide contact surface 26 in the case that a load is applied in a thrust direction in the slide portion 21. In the prior art mentioned above, the spacer receiving the load in the thrust direction is interposed, however, in the present invention, the load in the thrust direction is transmitted directly by the slide contact surface 26 between the rings. In other words, as the constituting parts interposed between the rings, there is only provided with a sealing means constituted by a pair of O-rings and face seals.

The third ring 11 is pressure inserted to the pin 14 in the same manner as the first ring 9. A slide portion 22 between both the rings has the same structure as that of the slide portion 21 mentioned above, and has only a sealing means 30 constituted by a pair of O-rings 16 and 16 and face seals 15 and 15, and a sealing surface 29 formed by the sealing means and a slide contact surface 27 between both the rings are positioned on the same flat plane.

Further, the first ring 9, the second ring 10 and the third ring 11 have respective diameters D_1 , D_2 and D_3 , and have a relation $D_1 < D_2 < D_3$. In accordance with the structure mentioned above, it is possible to easily fit to a member pivoting the pin assembly 20 and a pivotally supported member.

The pin assembly 20 having the structure mentioned above is especially exposed to a great load in both the radial and thrust directions, and is preferably used in the pivoting apparatus of the bogie having the track roller of the track-type drive system in which a lot of dusts exist in the environment where the system is used. Fig. 3 is a schematic view of a structure in the case of being applied to the pivoting apparatus of the bogie.

The bogie is constituted by a track roller (not shown in Fig. 3), a first bogie link 8 pivoted to the track frame 1, and a second bogie link 23 pivoted to the first bogie link 8 and corresponding to a pedestal of the track roller. The pin assembly 20 is used for pivoting the first bogie link 8 to the track frame 1 and pivoting the second bogie link 23 to the first bogie link 8. Details are as follows.

The track frame 1 is swingably attached to both side portions of a vehicle (not shown). A bracket 7 having an inverted U-shaped cross sectional shape is protruded from right and left sides of a lower portion of the track frame 1. An opening for the pin assembly 20 is provided in the bracket 7. One end of the first bogie link 8 is fitted and inserted to the bracket 7 from a lower side. The first bogie link 8 has an inverted L-shaped side elevational shape, and is structured such that one end is pivoted by the bracket 7 and another end is pivoted by the second

bogie link 23. Accordingly, openings for the pin assembly 20 are provided in one end and another end.

The pin assembly 20 is integrally pressure inserted to the opening of the bracket 7 from an outer direction of the first bogie link 8. The first link 9 and the third link 11 correspond to the opening of the bracket 7, and the second cylinder 10 corresponds to the opening in one end of the first bogie link 8. Inner diameters of the respective openings are set such diameters as to be interference fitted to the outer diameters D_1 , D_2 and D_3 of the rings. As a result, the first ring 9 and the third ring 11 are fitted to the bracket 7, and the second ring 10 is fitted to the first bogie link 8.

The second bogie link 23 pivotally supports the track roller in one end and another end, and has an opening for the pin assembly 20 in a center portion therebetween. In Fig. 3, there is illustrated only a plate in a side portion of the second bogie link. In the same manner as the pivotally supported portion mentioned above, the pin assembly 20 is pressure inserted to the opening in another end of the link from an outer side of the first bogie link 8. In accordance with the pressure insertion, the first link 9 and the third link 11 of the pin assembly 20 are firmly attached to the first bogie link 8, and the second link is firmly fitted to the second bogie link 23.

In accordance with the present invention, since the contact portions between the first ring and the second ring and between the second ring and the third ring are each constituted by substantially one flat plane in the radial direction of the pin assembly, the lubricant easily circulates around the contact portions and the obstacle in lubrication is hard to be generated. Further, since only the sealing means is interposed in the slide portion while abolishing the spacer, and the ring and the pin are structured as the integral pin assembly, it is possible to easily assemble the pin assembly itself and assemble the pivotally supported portion.

The description mentioned above is given only of the specific embodiments in accordance with the present invention, and the present invention is not limited to the embodiments. The other aspects of the present invention which those skilled in the art can carry out by studying the drawings, the specification and the claims are included in the technical scope of the present invention.

WHAT IS CLAIMED IS:

1. A pin assembly for a track roller bogie of a track-type drive system, comprising:

a pin having a lubricant charging hole and a lubricant delivering hole delivering the lubricant from the lubricant charging hole to an outer peripheral portion in an inner portion thereof;

a first ring having a contact surface with said pin in one end so as to be firmly attached to the pin and having an outer diameter D_1 ;

a second ring brought into contact with another end side of said first ring in an axial direction of the pin so as to be rotatably pivoted to the pin and having an outer diameter D_2 ; and

a third ring brought into contact with another end side of said second ring in an axial direction of the pin so as to be firmly attached to the pin and having an outer diameter D_3 ,

wherein a part of a ring end surface contacted among said first, second and third rings has an annular recess portion, and said annular recess portion consists of a sealing means between rings for sealing therebetween, and said outer diameters D_1 , D_2 and D_3 have a relation $D_1 < D_2 < D_3$.

2. A track-type drive system comprising:

a track roller bogie having a track frame, an idler, a sprocket, a carrier roller and a track roller and pivoted to said track frame; and

a crawler belt wound around them,

wherein the track roller bogie is pivoted to the track frame by the pin assembly as claimed in claim 1.

3. A track-type drive system comprising:

a track roller bogie having a track frame, an idler, a sprocket, a carrier roller and a track roller and pivoted to said track frame; and

a crawler belt wound around them,

wherein said track roller bogie is constituted by a first bogie link pivoted to the track frame, and a second bogie link pivoted to said first bogie link and to which the track roller is mounted, and

wherein said second bogie link is pivoted to said first bogie link by the pin assembly as claimed in claim 1.

4. The pin assembly according to claim 1, wherein the slide portion among said first ring, said second ring and said third ring is constituted by a slide contact surface with which each of the rings is directly contacted, and a seal surface of said sealing means in correspondence to each of the slide contact surfaces, and said slide contact surface and the seal surface form a substantially one flat

plane in a radial direction.

5. A track-type drive system comprising:

a track roller bogie having a track frame, an idler, a sprocket, a carrier roller and a track roller and pivoted to said track frame; and

a crawler belt wound around them,

wherein the track roller bogie is pivoted to the track frame by the pin assembly as claimed in claim 4.

6. A track-type drive system comprising:

a track roller bogie having a track frame, an idler, a sprocket, a carrier roller and a track roller and pivoted to said track frame; and

a crawler belt wound around them,

wherein said track roller bogie is constituted by a first bogie link pivoted to the track frame, and a second bogie link pivoted to said first bogie link and to which the track roller is mounted, and

wherein said second bogie link is pivoted to said first bogie link by the pin assembly as claimed in claim 4.

ABSTRACT OF THE DISCLOSURE

A track roller bogie is pivotally supported by a pin assembly, in which a spacer for receiving a thrust load is abolished and the thrust load is supported by outer rings of the pin assembly themselves. It makes possible to assemble a pin assembly easier and to elongate a service life of the track bogie.

Dclaration and Power of Attorney for Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

以下の氏名の発明者として、私は以下の通り宣言します。

As a below named Inventor, I hereby declare that:

私の住所、郵便番号、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole Inventor (if only one name is listed below) or an original, first and joint Inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

PIN ASSEMBLY FOR TRACK ROLLER

BOGIE OF TRACK-TYPE DRIVE SYSTEM

上記発明の説明書はここに添付されているが、下記の種がチャックされている場合、この限りでない：

の日本に提出された。
この発明の米国出願番号またはPCT国際出願番号は、
であり、且つ
の日本に提出された貴族（該当する場合）

the specification of which is attached hereto unless the following box is checked:

was filed on _____
as United States Application Number or
PCT International Application Number
and was amended on _____
(if applicable).

私は、上記の修正案によって修正された、特許請求範囲を含む上記説明書を検討し、且つ内容を理解していることをここに表明する。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編規則1.56に定められている、特許について並びに権利を表明する権利があることを認める。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基き下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365(a)項に基く国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Not Claimed 優先権主張なし <input type="checkbox"/>
			<input type="checkbox"/>
			<input type="checkbox"/>

私は、第35編米国法典119条(e)項に基いて下記の米国特許出願規定に記載された権利をここに主張いたします。

(Application No.) (出願番号)	(Day/Month/Year Filed) (出願日)	(Application No.) (出願番号)	(Day/Month/Year Filed) (出願日)

私は、下記の米国法典第35編120条に基いて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条(c)に基く権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願が提出日以降で本出願の日本国内または特許協力条約国提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

(Application No.) (出願番号)	(Day/Month/Year Filed) (出願日)	(Status: Patented, Pending, Abandoned) (現況: 特許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること。さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごく宣誓を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or Inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or Inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed

優先権主張なし

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Day/Month/Year Filed) (出願日)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application

(Status: Patented, Pending, Abandoned) (現況: 特許可済、係属中、放棄済)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
(日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続を米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。（弁護士、または代理人の氏名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name(s) and registration number(s))

R. Eugene Varndell, Jr. -- Reg. No. 29,728
Debra Shoemaker -- Reg. No. 47,941

書類送付先

Send Correspondence to:

VARNDELL & VARNDELL, PLLC
106-A South Columbus Street
Alexandria, VA 22314

直接電話連絡先：（名前及び電話番号）

Direct Telephone Calls to: (name and telephone number)

R. Eugene Varndell, Jr.
(703) 683-9730

唯一または第一発明者名		Full name of sole or first inventor	
		MURAKAMI, Shota	
発明者の署名	日付	Inventor's signature	Date
		Shota Murakami 29/09/2003	
住所		Residence	
		Hirakata-shi, Japan	
国籍		Citizenship	
		JAPAN	
私書箱		Post Office Address	
		c/o KOMATSU Ltd., Osaka Plant, Ueno 3-1-1, Hirakata-shi, Osaka, Japan 5731011	
第二共同発明者		Full name of second joint inventor, if any	
		YOSHIDA, Tsuyoshi	
発明者の署名	日付	Second inventor's signature	Date
		T. Yoshida 29/09/2003	
住所		Residence	
		Katano-shi, Japan	
国籍		Citizenship	
		JAPAN	
私書箱		Post Office Address	
		c/o KOMATSU Ltd., Osaka Plant, Ueno 3-1-1, Hirakata-shi, Osaka, Japan 5731011	

(第三以降の共同発明者についても同様に記載し、署名をすること)
(Supply similar information and signature for third and subsequent joint inventors.)

Fig.1

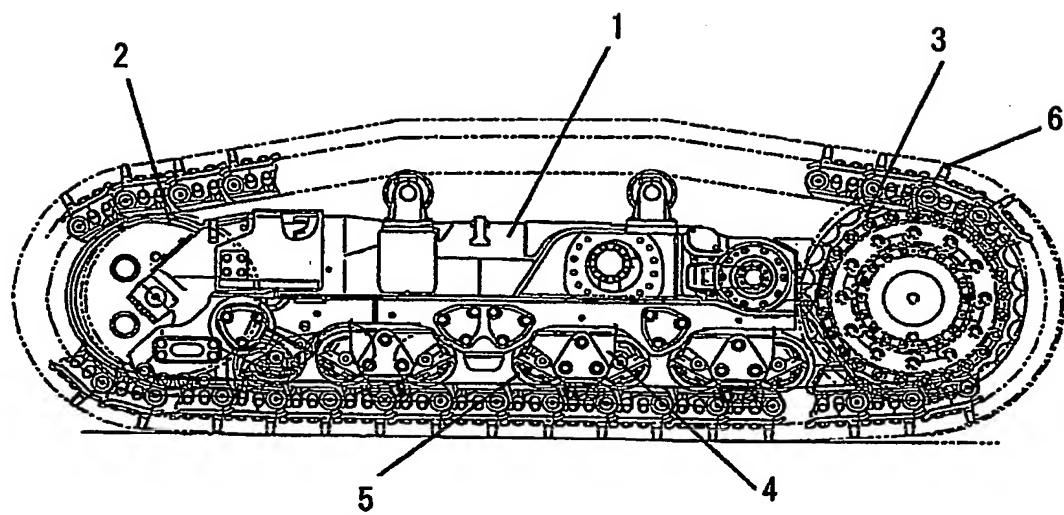


Fig.2

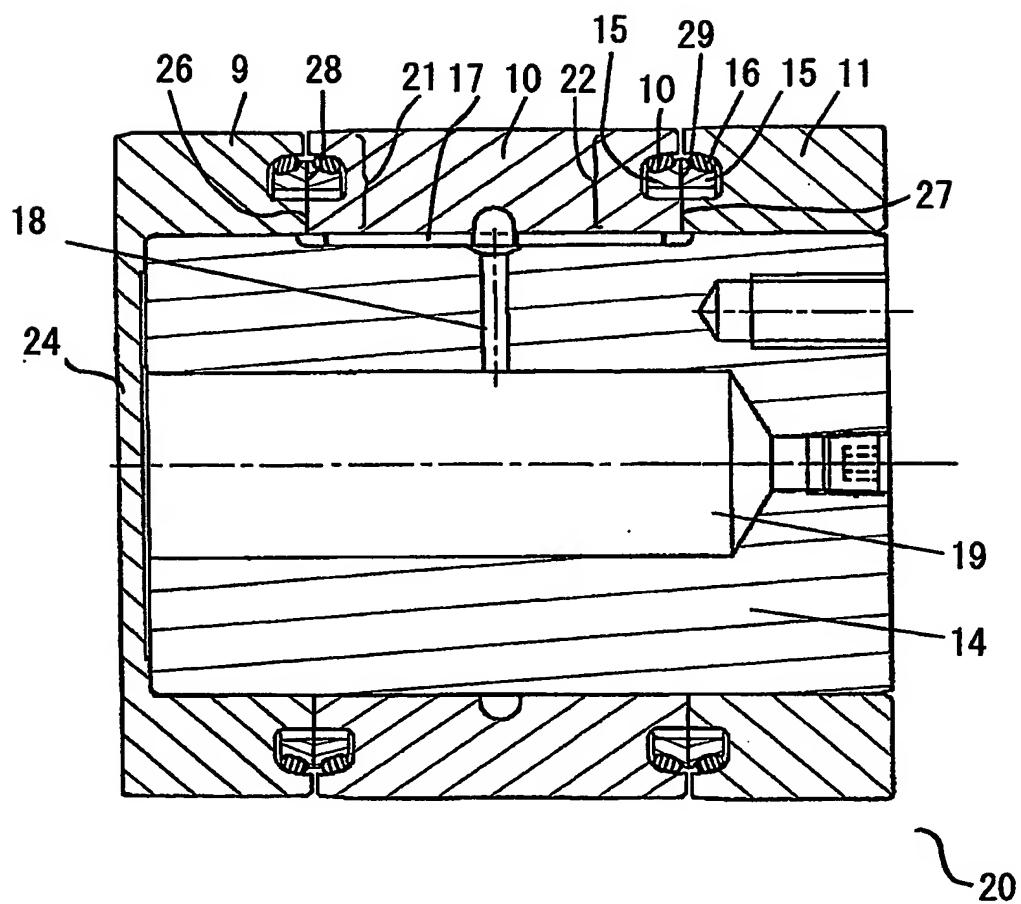


Fig.3

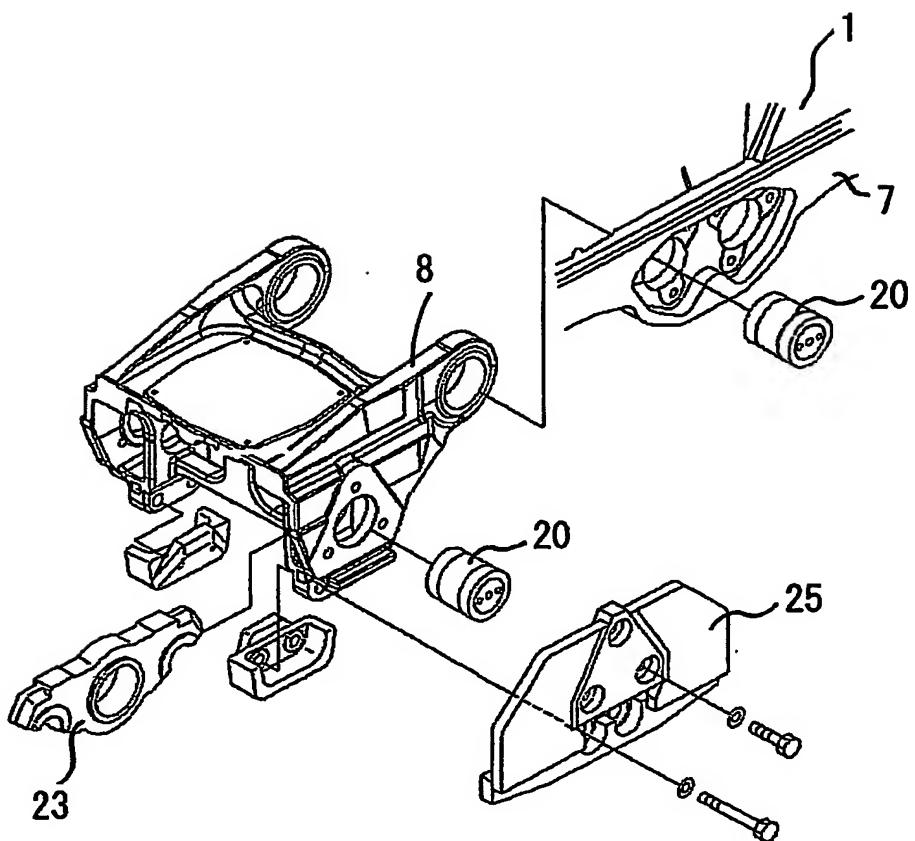


Fig.4
Prior Art

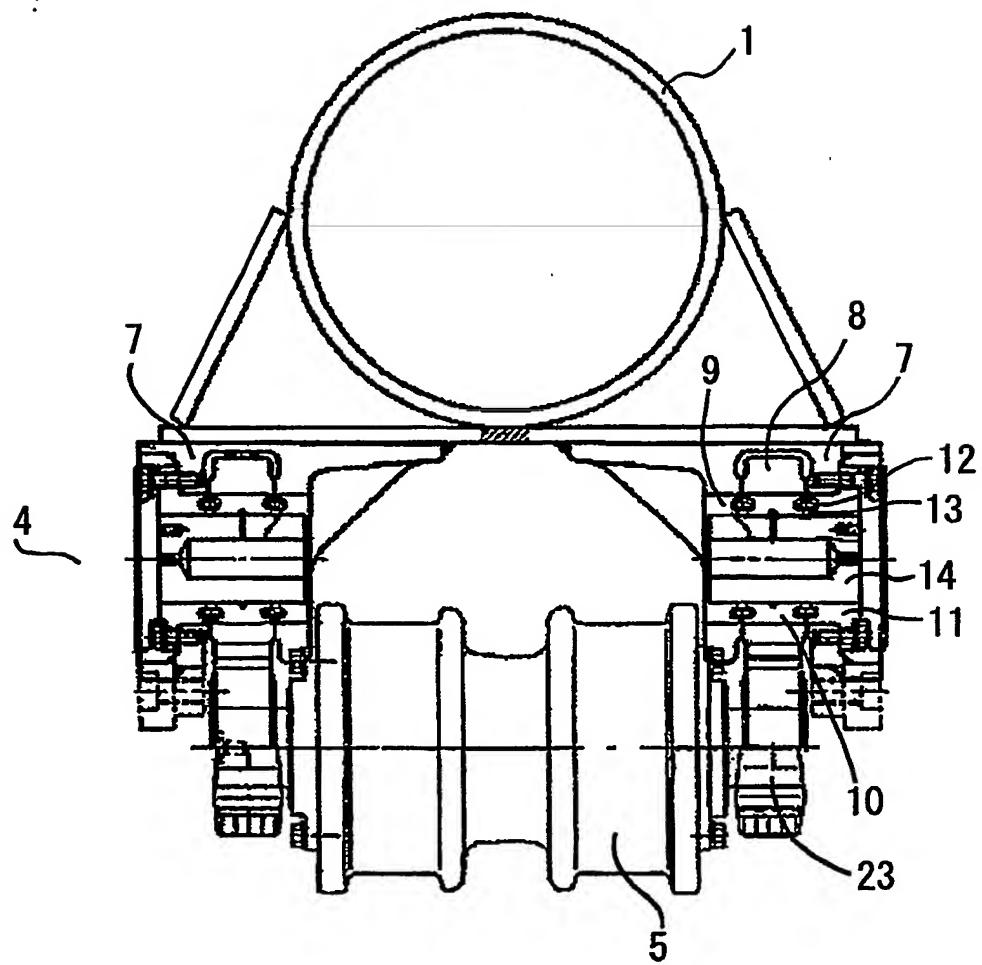
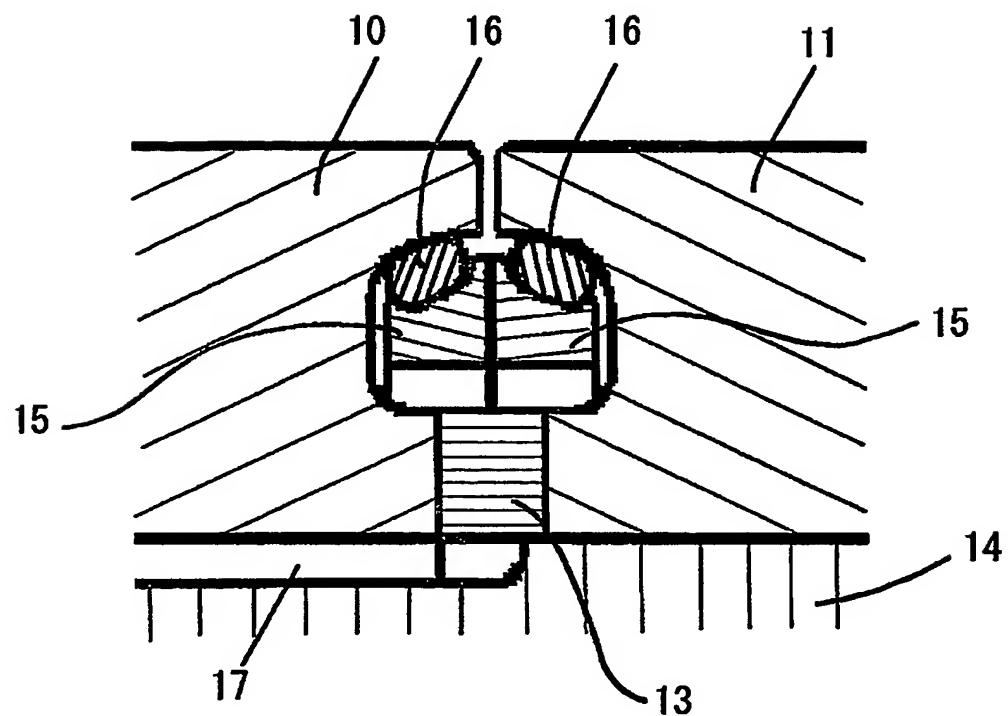


Fig.5
Prior Art



**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- BLACK BORDERS**
- IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- FADED TEXT OR DRAWING**
- BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- SKEWED/SLANTED IMAGES**
- COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- GRAY SCALE DOCUMENTS**
- LINES OR MARKS ON ORIGINAL DOCUMENT**
- REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.